

WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising steps of:
 - adding a metal element to a semiconductor film having an amorphous structure;
 - 5 crystallizing the semiconductor film having an amorphous structure to form a semiconductor film having a crystalline structure;
 - selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;
 - 10 gettering the metal element to the impurity region to selectively remove or reduce the metal element in the semiconductor film having a crystalline structure;
 - and
 - 15 removing the impurity region.
2. A method according to claim 1, wherein one kind or a plurality of kinds of elements selected from the group consisting of H, H₂, O, O₂, and P are added in addition to the rare gas element.
- 20 3. A method according to claim 1, wherein the selectively adding a rare gas element is conducted in an atmosphere containing a rare gas element and water vapor.
4. A method according to claim 1, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the impurity region.

5. A method according to claim 1, further comprising a step of oxidizing a surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

5 6. A method according to claim 1, wherein the crystallizing is conducted by heat treatment.

7. A method according to claim 1, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong
10 light.

8. A method according to claim 7, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure
15 mercury lamp.

9. A method according to claim 1, wherein the crystallizing is conducted by heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

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10. A method according to claim 9, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

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11. A method according to claim 1, wherein the gettering is conducted by heat treatment.

12. A method according to claim 1, wherein the gettering is conducted by 5 irradiation of the semiconductor film with strong light.

13. A method according to claim 12, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure 10 mercury lamp.

14. A method according to claim 1, wherein the gettering is conducted by heat treatment and irradiation of the semiconductor film with strong light.

15. A method according to claim 14, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

20 16. A method according to claim 1, wherein the metal element is one kind or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, Cu, and Au.

17. A method according to claim 1, wherein the rare gas element is one kind 25 or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.

18. A method of manufacturing a semiconductor device comprising steps of:

- adding a metal element to a semiconductor film having an amorphous structure;
- crystallizing the semiconductor film having an amorphous structure to
- 5 form a semiconductor film having a crystalline structure;
- forming a first mask on the semiconductor film having a crystalline structure;
- selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;
- 10 gettering the metal element to the impurity region to selectively remove or reduce the metal element in the semiconductor film having a crystalline structure;
- forming a second mask on the semiconductor film having a crystalline structure; and
- selectively removing the semiconductor film.

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19. A method according to claim 18, wherein the impurity region and a part of the semiconductor film having a crystalline structure are removed in the selectively removing the semiconductor film.

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20. A method according to claim 18, wherein the second mask is provided at a position on an inner side of the ends of the first mask.

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21. A method according to claim 18, wherein one kind or a plurality of kinds of elements selected from the group consisting of H, H₂, O, O₂, and P are added in addition to the rare gas element.

22. A method according to claim 18, wherein the selectively adding a rare gas element is conducted in an atmosphere containing a rare gas element and water vapor.

5 23. A method according to claim 18, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the semiconductor film.

10 24. A method according to claim 18, further comprising a step of oxidizing a surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

15 25. A method according to claim 18, wherein the crystallizing is conducted by heat treatment.

20 26. A method according to claim 18, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong light.

25 27. A method according to claim 26, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

28. A method according to claim 18, wherein the crystallizing is conducted by

heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

29. A method according to claim 18, wherein the gettering is conducted by heat
5 treatment.

30. A method according to claim 18, wherein the gettering is conducted by
irradiation of the semiconductor film with strong light.

10 31. A method according to claim 30, wherein the strong light is emitted from
a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a
xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure
mercury lamp.

15 32. A method according to claim 18, wherein the gettering is conducted by heat
treatment and irradiation of the semiconductor film with strong light.

33. A method according to claim 18, wherein the metal element is one kind
or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru,
20 Rh, Pd, Os, Ir, Pt, Cu, and Au.

34. A method according to claim 18, wherein the rare gas element is one kind
or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.

25 35. A method of manufacturing a semiconductor device comprising steps of:

forming a first mask on a semiconductor film having an amorphous structure;

selectively adding a metal element to the semiconductor film having an amorphous structure;

5 crystallizing the semiconductor film to form a semiconductor film having a crystalline structure;

selectively adding a rare gas element to the semiconductor film having a crystalline structure to form an impurity region;

10 gettering the metal element to the impurity region to selectively remove or reduce the metal element in the semiconductor film having a crystalline structure;

forming a second mask on the semiconductor film having a crystalline structure; and

selectively removing the semiconductor film.

15 36. A method according to claim 35, wherein the impurity region and a part of the semiconductor film having a crystalline structure are removed in the selectively removing the semiconductor film.

20 37. A method according to claim 35, wherein the second mask is provided at a position on an inner side of the ends of the first mask.

38. A method according to claim 35, wherein one kind or a plurality of kinds of elements selected from the group consisting of H, H₂, O, O₂, and P are added in addition to the rare gas element.

39. A method according to claim 35, wherein the selectively adding a rare gas element is conducted in an atmosphere containing a rare gas element and water vapor.

5 40. A method according to claim 35, further comprising a step of irradiating the semiconductor film with strong light or laser light from a front surface or a reverse surface to activate the impurity element after the removing the semiconductor film.

10 41. A method according to claim 35, further comprising a step of oxidizing a surface of the semiconductor film having a crystalline structure with a solution containing ozone after the crystallizing.

15 42. A method according to claim 35, wherein the crystallizing is conducted by heat treatment.

43. A method according to claim 35, wherein the crystallizing is conducted by irradiation of the semiconductor film having an amorphous structure with strong light.

20 44. A method according to claim 43, wherein the strong light is emitted from a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure mercury lamp.

25 45. A method according to claim 35, wherein the crystallizing is conducted by

heat treatment and irradiation of the semiconductor film having an amorphous structure with strong light.

46. A method according to claim 35, wherein the gettering is conducted by heat
5 treatment.

47. A method according to claim 35, wherein the gettering is conducted by
irradiation of the semiconductor film with strong light.

10 48. A method according to claim 47, wherein the strong light is emitted from
a lamp selected from the group consisting of a halogen lamp, a metal halide lamp, a
xenon arc lamp, a carbon arc lamp, a high-pressure sodium lamp, and a high-pressure
mercury lamp.

15 49. A method according to claim 35, wherein the gettering is conducted by heat
treatment and irradiation of the semiconductor film with strong light.

50. A method according to claim 35, wherein the metal element is one kind
or a plurality of kinds of elements selected from the group consisting of Fe, Ni, Co, Ru,
20 Rh, Pd, Os, Ir, Pt, Cu, and Au.

51. A method according to claim 35, wherein the rare gas element is one kind
or a plurality of kinds of elements selected from He, Ne, Ar, Kr, and Xe.